Henrietta Leavitt (1868-1921)

Henrietta Swan Leavitt was an American astronomer - "The woman who discovered how to measure the Universe". She discovered the relation between the luminosity and the period of Cepheid variable stars.

A graduate of Radcliffe College, Leavitt started working at the Harvard College Observatory as a "computer" in 1893, tasked with examining photographic plates in order to measure and catalog the brightness of the stars.

Leavitt's assignment was to identify variable stars, which are stars that change in brightness over a few hours, days, or weeks. To do this she would compare two photos of a star field taken a few days or weeks apart.

Figure 1. Leavitt along with the rest of women "computers" at Harvard College Observatory.

Leavitt worked on the variable stars in the Magellanic Clouds – a distant star cluster. She was astonished at the number of variable stars she discovered in these clouds – 969 in the small cloud and 808 in the large cloud, making a total of 1,777. But what she noticed in about 25 of these stars changed astronomy forever.

She found that a certain type of star, the Cepheid variable, pulses at a rate that's related to its brightness. A Cepheid variable star's pulse rate reveals the star's true, fundamental brightness. The amount by which the star's brightness is dimmed by distance allows the star's distance from the earth to be calculated.

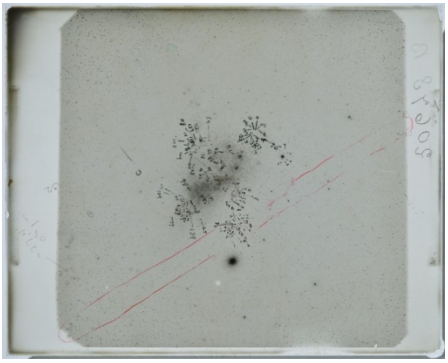


Figure 2. Leavitt It's believed that Plate B20678 is the plate Henrietta Leavitt used to study variable stars in the Small Magellanic Cloud. (Courtesy Lindsay Smith)

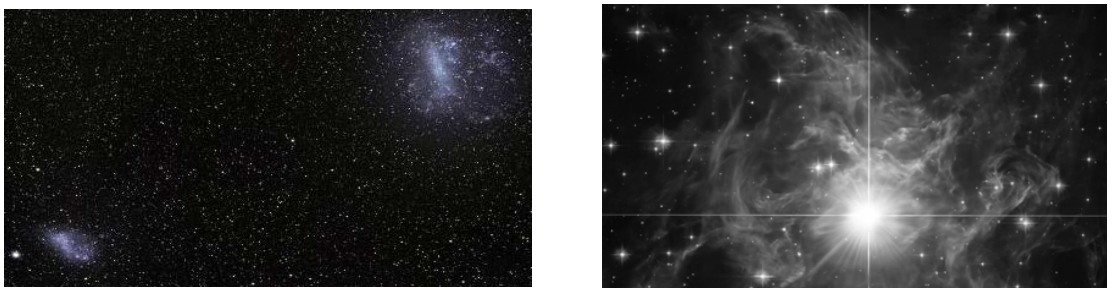


Figure 3. (on the left) The Small and Large Magellanic Clouds Image courtesy of ESA. (on the right) Variable star RS Puppis.

She plotted a graph of data from 25 Cepheids in the Small Magellanic Cloud. The graph related the period of each star to its maximum and minimum brightness, to get the straight lines shown below:

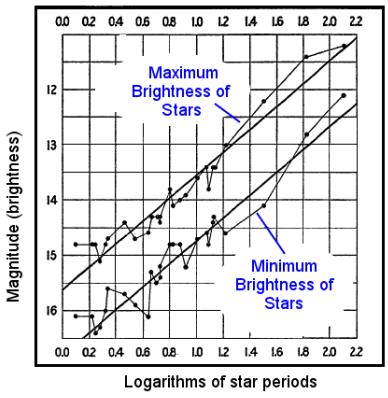
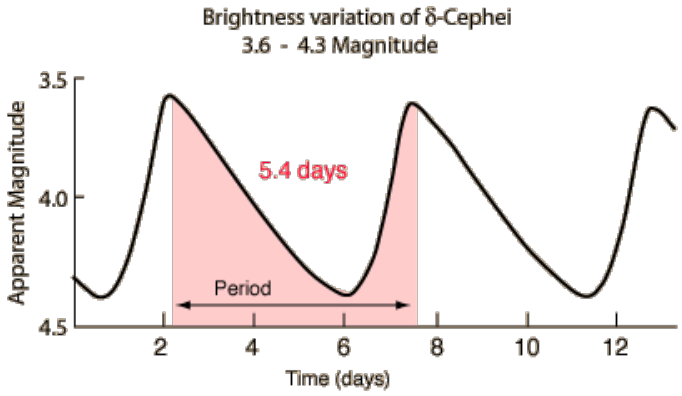


Figure 4. Leavitt's graph of data from 25 Cepheids in the Small Magellanic Cloud.

Making the assumption that all the Cepheids in the Small Magellanic Cloud lie at the same distance from the earth, Leavitt deduced that the fundamental brightness of a Cepheid is directly related to its pulse rate.

Her assignment at the time was to catalogue stars, not to investigate them. She made this famous and extremely valuable discovery on her own initiative.

Her discovery, is known as the "period–luminosity relationship" or "Leavitt's law": The logarithm of the period is linearly and directly related to the logarithm of the star's average intrinsic optical luminosity (which is the amount of power radiated by the star in the visible spectrum). In Leavitt's words, "A straight line can be readily drawn among each of the two series of points corresponding to maxima and minima, thus showing that there is a simple relation between the brightness of the Cepheid variables and their periods."



Leavitt published her first paper on the period-luminosity correlation in 1908, and four years later she published a table of the periods of 25 Cepheid variables. Nine years later, in 1921, she died of cancer at age 53 in Cambridge, Massachusetts.

Leavitt's work was pivotal to the development of astronomy, astrophysics, and cosmology. Magnus Gösta Mittag-Leffler of the Swedish Academy of Sciences tried to nominate her for the 1926 Nobel Prize in physics, but discovered that she was no longer alive. Nobel Prizes are not awarded posthumously.

By discovering the distance key, Henrietta Swan Leavitt made possible all of the subsequent discoveries in astronomy of the 19th and 20th centuries.

A few years later a team of astronomers did just that, making it possible to measure the distance to any Cepheid in just three steps:

a) Measure the period of the star. b) Use Leavitt's graph to determine how bright it really is. c) Measure how bright it appears and determine its distance.

Figure 4. Hubble used Leavitt's law to establish that the Andromeda Nebula is actually another galaxy. Image courtesy NASA/JPL.

After Leavitt's death in 1921, Edwin Hubble used the relationship between the period and luminosity of the Cepheid variables to determine that the Universe was expanding. Decades later in the 1990s, astronomers built on this work by discovering that the expansion is, in fact, accelerating. In 2011, the Nobel Prize in Physics was awarded for this discovery.